GARBER, R.I.

PHASE I BOOK EXPLOITATION SOV/5305

Moscow. Institut stali

Relaksatsionnyye yavleniya v metallakh i splavakh; trudy Mezhvuzovskogo soveshchaniya (Relaxation Phenomena in Metals and Alloys; Transactions of the Inter-Institute Conference) Moscow, Metallurgizdat, 1960. 326 p.

Sponsoring Agency: Ministerstvo vysshego i srednego spetsial'nogo obrazovaniya RSFSR and Moskovskiy institut stali imeni I.V. Stalina.

Ed. (Title page): B.N. Finkel'shteyn; Ed. of Publishing House: Ye.I. Levit; Tech. Ed.: A.I. Karasev.

PURPOSE: This collection of articles is intended for personnel in scientific institutions and schools of higher education and for physical metallurgists and physicists specializing in metals. It may also be useful to students of these fields.

COVERAGE: The collection contains results of experimental and theoretical investigations carried out by schools of higher education and scientific research institutions in the field of the relaxation phenomena in metals and alloys. Several articles are devoted to the investigation—by the internal-friction method—of the decomposition of supersaturated solid solutions. Also analyzed are the defects of the crystalline lattice, plastic deformations, high-temperature behavior of alloys, and creep. Problems of the relation between internal friction and temper brittleness, the use of the method of internal friction in the investigation of powder-metallurgy products, and the mechanism of impact fatigue are discussed. The collection also contains articles on the damping characteristics of materials, elastic after-effect, and the new slow-detection method. No personalities are mentioned. References follow most articles. There are 366 references: 192 Soviet and 174 non-Soviet.

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GARBER, R. I.; POLYAKOV, L. M.

Investigating sub-microscopic nonuniformities of rock salt after plastic deformation. Fiz. tver. tela 2 no.5:974-981 My '60. (MIRA 13:10)

1. Fiziko-tekhnicheskiy institut AN USSR, Khar'kov.
(Salt) (Deformations (Mechanics))

81616

S/181/60/002/006/04/050
B122/B063

21.1330
18.8100

AUTHORS: Garber, R. I., Zalivadnyy, S. Ya., Mikhaylovskiy, V. M.

TITLE: Change in the Microstructure of Uranium by Cyclic Heat Treatment 21

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 6, pp. 1052-1059

TEXT: When subjected to cyclic heat treatment, uranium exhibits irreversible growth which has been given different explanations in publications. In order to clarify this problem, the authors of the present paper examined the change in the microstructure of uranium, i.e., the process taking place inside and on the grain boundaries of polycrystalline uranium during cyclic heat treatment. The metal surface was examined microscopically and photographed with a camera of the type МФН-1 (MFN-1). Fig. 1 shows the scheme of the system. The uranium samples were prepared in such a way that coarse, columnar grains developed in the center of the sample (Fig. 2). The deformation of the grains was observed by the changes in etched lines. Sample No. 1 was

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heated 200 times from 100 to 600°C, No. 2 300 times, and No. 3 50 times in the course of 5 min, cooling took 4 min, the peak temperature lasted 1 min. Figs. 3-6 illustrate the changes undergone by the samples No. 1-3. A curvature in the etched lines and a mutual displacement of the grains was observed in all samples. In some cases, a distortion of the grain boundaries was observed in addition to the mutual displacement. It was further observed that at peak temperature there was a jump in the lines, which again vanished on cooling. The direction of these jumps changed after about 10 cycles, and remained the same on a further cyclic treatment. This thermoelastic deformation is assumed to be related with the anisotropic thermal expansion of uranium. The disorientation of the grains in the course of the cyclic treatment is examined roentgenographically. The greatest possible displacement of grains was determined from the degree of disorientation and the difference between the thermal expansion coefficients of touching bodies; the displacement corresponding to the mechanism of "thermal wedging" is likewise determined and compared with the displacement observed experimentally. The displacement observed was found to differ only little from the one determined by the

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Change in the Microstructure of Uranium by Cyclic Heat Treatment

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mechanism of "thermal wedging", whereas it is two orders smaller than the greatest possible, i.e., only a small part of the thermoelastic displacements becomes irreversible. It was further established by X-ray pictures (multiplication of the original spots on the single crystals) that a splitting of the grain takes place in blocks by cyclic thermal treatment. The residual displacement of grains, which ultimately causes the uranium growth, is ascribed to the formation of undersize grains, the plastic deformation in the boundary zone of weak grains, and the displacement of grains on their cooling. There are 8 figures, 1 table, and 11 references: 7 Soviet and 1 British.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR, Khar'kov (Physicotechnical Institute of the AS UkrSSR, Khar'kov)

SUBMITTED: February 24, 1958

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81620
S/181/60/002/06/08/050
B122/B063

18.8200

AUTHORS: Garber, R. I., Gindin, I. A., Polyakov, L. M.

TITLE: Dispersion and Re-establishment of Contacts Between Micro-blocks During Plastic Deformation 26

PERIODICAL Fizika tverdogo tela, 1960, Vol. 2, No. 6, pp. 1089 - 1095

TEXT: The low strength of solid bodies after deformation is ascribed to dislocations, fractures, and microcracks and the resulting concentration of strains which attain the value of theoretical strength in microregions. Furthermore, the formation, splitting, and disorientation of microblocks are observable. The concentration of strains may be regarded as an increase in latent energy which is due to the extension of the inner surface brought about by disorientation. The surface energy of the liberated parts of the block surfaces would pass over into latent energy. The block dimensions themselves have a specific value for every material. According to B. M. Rovinskiy and L. M. Rybakova (Ref. 7), this value constitutes a mean value of split and restored blocks. In this connection, the saturation of the latent deformation energy corresponds to the stabilization of the mean block

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Dispersion and Re-establishment of Contacts Between Microblocks During Plastic Deformation

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dimensions. The surface energy is determined by formula: $\gamma = \frac{\alpha}{\beta} \frac{l\varrho Q}{\sigma}$ (1), where $\alpha = v/l^3$, v denotes the volume of the block, l its length, $\beta = S/l^2$, S is the surface, ϱ is the material density, Q is the latent energy of plastic deformation on saturation referred to the sample mass, and σ is the mean surface tension. As an example, γ has the value 0.5 for copper, i.e., on plastic deformation of copper a considerable part of the block surfaces is without contact with the neighboring blocks. It is then considered that a part of the latent deformation energies must be also ascribed to other causes, such as lattice defects, dislocations, and residual stresses. The latter are determined in metals roentgenographically, and do not amount to more than 2 % of Q. Atomic dispersion and imperfections, determined from the change of resistivity as a result of plastic deformation, correspond to only 5 % of the latent energy Q. Thus, almost the entire latent energy of the plastic deformation was found to be present as the energy of the free block surfaces. The process of contact re-establishment was studied on pressed and high-vacuum heated copper disks, on the change of the flow velocity of hydrogen through iron tubes, which were deformed at the temperatures of liquid nitrogen, and finally, on the change, caused by annealing,

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Dispersion and Re-establishment of Contacts Between Microblocks During Plastic Deformation

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in light dispersion intensity of deformed rock salt samples. The setups used for the investigation are shown in Figs. 1 - 5, and respective results in Figs. 6 - 9. The studies revealed that the activation energy of contact formation in copper decreases with rising pressure, i.e. the said formation proceeds very quickly at a certain pressure and also at low temperatures. In the case of iron, a recrystallization occurs under the given conditions, which, however, does not necessarily give rise to contacts. It is concluded therefrom that at a certain deformation stage there is a firm interlinkage between the various contact faces of the blocks besides dispersion and disorientation. There are 9 figures and 15 references: 10 Soviet, 3 English, 1 Japanese, 1 American.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR, Khar'kov (Physico-technical Institute of the AS UkrSSR, Khar'kov)

SUBMITTED: August 11, 1959

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81621
S/181/60/002/06/09/050
B122/B063

18.8200

AUTHORS: Garber, R. I., Gindin, I. A., Lazarev, B. G., Starodubov, Ya.D.
[redacted]

TITLE: Low-temperature Recrystallization of Copper

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 6, pp. 1096 - 1098

TEXT: The authors of the present article studied the recrystallization of copper which was first deformed at the temperatures of liquid hydrogen and nitrogen, and was then subjected to recrystallization at room temperature. Tubular copper samples (diameter: 1.5 mm; wall thickness: 0.45 mm) were used. The samples were first annealed at 800°C for 8 hours (at 10^{-6} torr). Special care was devoted to the perfect cleanliness of the inner wall of the tube. The sample was deformed in vacuo at 20 and 4.2°K perpendicular to the tube axis until the inner walls touched, and further, until the plastic deformation $\delta = 23$ %. The sample was then heated at low pressure, and kept at room temperature for 10 - 15 hours. Recrystallization was observed on a cut of the cross section of the tubes after deep etching, by using a metallographical microscope of the type МИМ-6 (MIM-6) (Figs. 1 and 2). Small

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GARBER, R.I.; STEPINA, Ye.I.

Etching figures of wedged elastic twins. Kristallografiia 5 no.5:811-813 S-O '60. (MIRA 13:10)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Crystallography) (Calcite)

18.8200
5.2100

68030

S/126/60/009/02/019/033
E032/E314

AUTHORS: Garber, R.I., Zalivadnyy, S.Ya. and Gorokhovatskiy, F.S.

TITLE: Determination of the Anisotropy in the Microhardness of Beryllium Crystals

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol 9, Nr 2, pp 274 - 278 (USSR)

ABSTRACT: The aim of the present work was to study the anisotropy in the microhardness of a single crystal of beryllium. The study was made on 99.4% pure monocrystalline beryllium. The crystallization was carried out at 10^{-6} mm Hg in the apparatus shown schematically in Figure 1, in which 1 is a beryllium oxide crucible which has a hemispherical bottom and conical side walls, 2 is the crucible cover, 3, 4, 5 and 6 are electrical heaters, 7 is a jacket, 8 and 9 are screens, 10 is a support, 11, 12, 13 are apertures for thermocouples and 14, 15, 16, 17 and 18 are leads for the electrical heaters. The temperature of the molten material was brought up to 1 400 °C (120 °C above the melting point of beryllium). It was held at that temperature for about one hour and then uniformly cooled from the bottom upwards.

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E032/E314

Determination of the Anisotropy in the Microhardness of Beryllium Crystals

The crystallized beryllium was then removed from the apparatus after being cooled down to room temperature. The specimens were worked into a spherical form and suitably polished and the microhardness was determined at the points indicated in Figure 2 (circles). The specimens were orientated with the aid of X-ray diffraction photographs which were also used to judge the quality of the specimens. The microhardness was then measured using the PMT-2 microhardness gauge with a load of 100 g. Typical polar diagrams are shown in Figures 4 and 5 which refer to the plane containing C_6 and the plane perpendicular to C_6, respectively. It is concluded that the microhardness diagram for beryllium is close to an ellipsoid of revolution about the sixfold axis, the ratio

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E032/E314

Determination of the Anisotropy in the Microhardness of Beryllium Crystals

of the axes of the ellipsoid being 0.62 (217 kg/mm^2 and 350 kg/mm^2 perpendicular and along the C_6 axis).

There are 5 figures, 1 table and 3 references, 1 of which is German, 1 Soviet and 1 English.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Physico-technical Institute of the Ac.Sc. Ukrainian SSR)

SUBMITTED: April 2, 1959

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GARBER, R.I.; POLYAKOV, L.M.

Distribution of residual stresses in plastically deformed rock salt crystals. Fiz. met. i metalloved. 10 no.3:462-471 S '60. (MIRA 13:10)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Rock salt) (Dislocations in crystals)

85044

1.2310 2308, 2708 only

S/126/60/010/004/014/023
E021/E406

AUTHORS: Garber, R.I., Polyakov, L.M. and Malik, G.N.

TITLE: Welding of Copper by Exposure to Sonic Vibrations

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol.10, No.4, pp.590-596

TEXT: Investigations were carried out using an oscillator, a magnetostriction device, an arrangement for loading and a vacuum chamber. The apparatus is shown in Fig.1. The specimens were simultaneously loaded with static and dynamic pressures. The experiments were carried out in a vacuum of 10^{-5} mm mercury. The influence of the applied pressure, the temperature, the time and regime of vibrations on the strength of the joint were investigated. The samples were heated by a molybdenum heater and shields of thin sheets of stainless steel. The samples were prepared from oxygen-free copper in the form of a disc, 16 mm in diameter and 10 mm high (Fig.2). The strength of the joints was tested on an ИМ-4Р (IM-4R) machine. The optimum time of exposure to sonic vibrations in order to produce the strongest joint is 20 to 30 seconds at 825°C and a pressure of 1.5 kg/mm^2 (curve 1, Fig.3) and 2 to 3 minutes at 700°C and a pressure of 2.5 kg/mm^2 (curve 1,

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Welding of Copper by Exposure to Sonic Vibrations

Fig.4). The curves were obtained after a ten minute heat treatment after the sonic treatment at the same temperature. Curves 2 in Figs.3 and 4 show the strength of joint without the sonic vibrations. To obtain joints of similar strength to those obtained with vibrations, the pressure has to be maintained for one hour at 825°C or three hours at 700°C without the application of vibrations. Thus the time is considerably reduced by the use of the vibrations. Fig.6 shows the microstructure of a specimen after 4 minutes application of vibrations at 600°C (the optimum time for this temperature). The grain size is 3 to 4 times smaller than that of the original material. The strength of this sample was 19 kg/mm^2. After 20 minutes vibration, the grain size becomes coarser and cracks begin to develop (Figs.7,8). The strength fell to 14 to 15 kg/mm^2. Fig.9 shows a sample after 10 minutes vibration at 825°C. Cracks have developed in the grain boundaries of the coarse grains. Fig.10 shows the relation between the strength of the joint and static pressure at 600°C, Curve 1 is after 4 minutes vibration treatment, curve 2 after 10 minutes and curve 3 after 3 minutes treatment without vibrations. It can be
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E021/E406

Welding of Copper by Exposure to Sonic Vibrations

seen that with vibrations the static pressure can be considerably reduced to obtain the same strength. The use of vibrations also enables joints to be obtained with low values of plastic deformation of the samples. There are 11 figures and 8 references: 6 Soviet, 1 German and 1 English.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR
(Physics and Engineering Institute AS UkrSSR)

SUBMITTED: February 29, 1960

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S/126/60/010/006/020/022
E201/E491

AUTHORS: Garber, R.I. and Soloshenko, I.I.

TITLE: The Dependence of the Damping Decrement on the Amplitude of Elastic Vibrations and the Plastic Deformation of Overstressed Micro-Regions

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol.10, No.6, pp.934-937

TEXT: The authors show that changes of the damping decrement (δ) indicate that hardening of crystals by plastic deformation at large vibration amplitudes (a) does not preclude hardening at small vibration amplitudes. For each effective stress (σ) there is a set of weak points which can be cured by plastic deformation. To verify these theoretical conclusions, the damping decrement was measured at various values of N (the total number of vibrations) and σ for rocksalt monocrystals and polycrystalline plates of commercial lead. All measurements were carried out at 1 c/s at room temperature. The results for rocksalt (Fig.1 and 2) and lead (Fig.3), plotted in the form of δ(N) curves at various values of σ, confirmed the conclusions arrived at theoretically. There

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E201/E491

The Dependence of the Damping Decrement on the Amplitude of Elastic Vibrations and the Plastic Deformation of Overstressed Micro-Regions

are 3 figures and 6 references: 5 Soviet and 1 non-Soviet.

ASSOCIATION: Khar'kovskiy gosudarstvennyy pedagogicheskiy institut fizicheskogo vospitaniya im. G.S.Skovorody (Khar'kov State Pedagogical Institute for Physical Training imeni G.S.Skovoroda)

SUBMITTED: June 7, 1960

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24(2), 18(0)
AUTHORS: Garber, R. I., Gindin, I. A.

S/053/60/070/01/002/007
B006/B017

TITLE: The Physics of the Strength of Crystal Bodies

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol 70, Nr 1, pp 57-110 (USSR)

ABSTRACT: Although modern engineering makes ever increasing demands on the strength of materials there exists no modern physical theory of strength. The present paper gives a survey on the up-to-date physical concepts on the strength of crystalline bodies, the reasons for the low strength of the real materials, and the most important possibilites of raising them. Part 1 deals with the microscopic theory of strength, especially with the theory by Ya. I. Frenkel'; Frenkel' proved that the critical shear stress in the case of which the lattice becomes unstable is equal to $G/2\pi$ where G denotes the modulus of rigidity; this value is much higher than that for plastic crystals ($10^{-5}G$). By more accurate investigations other authors obtained a still theoretical value of G/30 which is much higher than that measured in single metal crystals. The reasons for this discrepancy are briefly discussed. Part 2 deals with the structural defects of a real crystal and gives a short survey. Part 3 deals somewhat more in detail with the influences of the microcracks

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The Physics of the Strength of Crystal Bodies

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(P. A. Rebinder, Ya. I. Frenkel', B. Ya. Pines, A. F. Ioffe, S. N. Zhurkov, A. V. Stepanov; experiments and their results are mentioned). Part 4 reports on the scale effect and the strength of the thread-like crystals (A. P. Aleksandrov, S. N. Zhurkov - statistical theory, R. I. Garber - experiments with calcite crystals; figures 3-9 show different characteristics of strength, also Bartenov and Chepkov are mentioned). Part 5 gives a short survey on the statistical theory by N. N. Davidenkov, Ya. I. Frenkel' and T. A. Kontorova, and part 6 deals with the origin of cracks in the crystal nucleus (theory by A. V. Stepanov and its verification by N. N. Davidenkov, Ye. M. Shevandin, and M. V. Klassen-Neklyudova; experiments and their results obtained by S. O. Tsobkallo, Stepanov, S. N. Zhurkov, T. P. Sanfirova et al). Part 7 presents the theoretical and experimental investigation results of dislocations and microcracks (Ye. D. Shchukin and V. I. Likhtman). Part 8 investigates the influence of the surrounding medium on the mechanical strength of solids (solution of the body and extension of surface defects and adsorption; A. F. Ioffe, P. A. Rebinder, D. I. Shil'krug). Part 9 deals with the dependence of strength,

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The Physics of the Strength of Crystal Bodies S/053/60/070/01/002/007
B006/B017

on temperature and time (I.V. Obreimov, S. N. Zhurkov, B. Ya. Pines, I. Ya. Dekhtyar, T. P. Sanfirova, and K. A. Osipov). Part 10: destruction on creeping, part 11: cold brittleness (theory by Ioffe for rock salt; experiments by N. N. Davidenkov and T. N. Chuchman; microstructure photographs by Garber, Gindin, Konstantinovskiy, Starodubov). Part 12: discussion of the structure of high-strength alloys (G. V. Kurdyumov, B. M. Rovinskiy, L. M. Bybakova, B. M. Rovinskiy, Perkas, and Khondras, V. A. Il'ina, V. K. Kritskaya, Gruzin, Tyutyunik, Entin, V. I. Startsev, P. N. Aronova). Part 13 and 14 are devoted to fatigue and hardening; the two types of hardening are briefly discussed according to R. I. Garber. In conclusion it is then pointed out that the strong difference between theoretical and experimental strength is due to structural defects and that strength could be increased by a regular stress distribution in thermal and mechanical processing. There are 38 figures and 223 references, 108 of which are Soviet.

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GARBER, R.I.; SOLOSHENKO, I.I.

Effect of annealing on the decrease in the damping of an alternating elastic-plastic flexure. Fiz. met. i metalloved. 12 no.1:153-155 Jl '61. (MIRA 14:8)

1. Khar'kovskiy pedagogicheskiy institut imeni G.S.Skovorody.
(Metal crystals) (Deformations (Mechanics))

S/181/61/003/001/021/042
B006/B056

AUTHORS: Garber, R. I. and Gindin, I. A.

TITLE: Elastic deformation and thermal expansion

PERIODICAL: Fizika tverdogo tela, v. 3, no. 1, 1961, 176-177

TEXT: When investigating deformations with temperature changes, thermal expansion is usually considered to be independent of deformation; the explanation of certain effects occurring in the temperature change of elastically deformed specimens, however, requires consideration of the stress dependence on the coefficient of thermal expansion. This may be done by taking third-order terms into account in the series expansion of the energy of elasticity. Whereas this is not possible in general, not only the required stress dependence of the expansion coefficient may be determined, but also the coefficients entering into the latter may be estimated for the special case of uniaxial deformation or uniform expansion in all directions. This is done in the present work. For a diatomic solid, the stress $\sigma = -f\varepsilon + g\varepsilon^2$ (1), where ε is the relative deformation, and f and g are constants. If ε is considered the sum of shifts due to applied

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forces (ε_1) and to thermal vibrations (ε_2), then $\sigma = \sigma_1 + (2g\varepsilon_1 - f)\varepsilon_2 + g\varepsilon_2^2$. Averaging over time gives $\bar{\sigma} = \sigma_1$ and $\overline{\varepsilon_2} = g\overline{\varepsilon_2^2}/(f-2g\varepsilon_1)$. $\overline{\varepsilon_2^2}$ may be determined from the mean density of the energy of elasticity of thermal vibrations: $\overline{W} \simeq \int_0^T \frac{C_V}{V}\,dT$, and $\overline{W} = -f\overline{\varepsilon_2^2}/2 + g\overline{\varepsilon_2^3}/3$. By taking into account that ε_2^3 small quantity changing its sign, one may assume that $\int_0^T \frac{C_V}{V}\,dT \simeq -f\overline{\varepsilon_2^2}/2$. If $\overline{\varepsilon_2} = \int_0^T \alpha\,dT$, where α is the coefficient of thermal expansion, one obtains $\alpha = 2gC_V/Vf(2g\varepsilon_1 - f)$. With $\sigma_1 = 0$, $\varepsilon_1 = 0$, $\alpha = \alpha_0 = -2gC_V/Vf^2$, one obtains $\alpha = \alpha_0(1+\beta\varepsilon_1)$. On the other hand, it follows from the Grüneisen relation that $\alpha_0 = KC_V\gamma/3V$, where K denotes compressibility, γ the Grüneisen coefficient, V the atomic volume. Thus, one obtains $\beta = -Kf\gamma/3$. From (1)

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it follows that $f \simeq -E$, where E is the modulus of linear elasticity. The value of β was calculated for several metals:

Metal	β
Pd	1.3
Ag	1.65
Pt	1.65
Cu	1.7
α-Fe	1.9
Ni	2.1
W	2.1
Co	2.3

Small deformations naturally lead to comparatively low changes in the coefficient of thermal expansion; in the case of high stress gradients, the change may become considerable and cause noticeable effects. There are 1 table and 1 Soviet-bloc reference.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology AS UkrSSR, Khar'kov)

SUBMITTED: June 6, 1960

GARBER, R.I.; STEPINA, Ye. I.

Defects on the boundaries of twin interlayers. Fiz. tver. tela. 3 no.2:514-519 F '61. (MIRA 14:6)

1. Fiziko-tekhnicheskiy institut AN USSR, Khar'kov.
(Crystals—Defects)

20798

24.7500 1143, 1160, 2807, 1418 S/181/61/003/003/024/030
B102/B205

AUTHORS: Garber, R. I., Gindin, I. A., and Shubin, Yu. V.

TITLE: High strength of single crystals

PERIODICAL: Fizika tverdogo tela, v. 3, no. 3, 1961, 918-919

TEXT: Numerous experimental studies of crystals of rock salt and other substances, performed by A. F. Ioffe and A. V. Stepanov, seem to indicate that the continuity of the crystals is disturbed in plastic deformation. By retarding or accelerating the plastic deformation of rock crystal, Stepanov was able to change their strength by a factor of 30. The highest strength is displayed by filament crystals if the entire process of deformation up to destruction is plastic. Iron filaments elastically deformed by 4.8%, for example, reach a strength of 1340 kg/mm^2. When the first indications of sliding are noticeable, the resistance of filament crystals to resistance decreases rapidly. If the orientation of a macroscopic crystal toward the external force is such that plastic deformation (chiefly sliding and twinning) is excluded, increased strength can be expected. Hexagonal crystals which have a limited number of slip and twinning planes at low temperatures, are partic-

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High strength ...

ularly suitable for such experiments. Plastic deformation of these crystals is effected chiefly by sliding in the basal plane (0001), on the faces of prisms of first order {10$\bar{1}$0}, and by twinning in the planes {10$\bar{1}$2}. This was studied with the help of prismatic Be single crystals (1.6 × 1.5 × 3 mm) of 99.9% purity. The crystals were compressed at 77°K by a force perpendicularly acting on the basal plane (deformation rate: 0.013%/sec). There were no indications of plastic deformation up to destruction. Sliding and twinning were impossible since no components of this force were acting in the respective directions. Under these conditions, the Be single crystals actually showed a very high strength: destruction occurred only under a pressure of 410 kg/mm^2; the crystal suddenly decomposed into very fine powder. With other positions of the basal plane, destruction occurred already at 34 kg/mm^2. At room temperature, the maximum stress is only 210 kg/mm^2 (perpendicular to the basal plane). Similar experiments were carried out with calcite single crystals (6 × 4 × 10 mm) at 300°K, which are deformed only by twinning. The orientation of the single crystals was such that the twinning plane (110) formed an angle of 45° with the axis of the specimen and the direction of displacement [001], opposite to the direction in which the tangential stresses acted, which deformed the specimen at a

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B102/B205

High strength ...

rate of 0.004%/sec. A strength of 23 kg/mm^2 was attained in this case. The lower bound is 40 g/mm^2. There are 7 references: 4 Soviet-bloc and 3 non-Soviet-bloc.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology, AS UkrSSR, Khar'kov)

SUBMITTED: August 10, 1960

X

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22051

S/181/61/003/004/017/030
B102/B214

24.7500 1160, 1136, 1143

AUTHORS: Garber, R. I., Gindin, I. A., and Shubin, Yu. V.

TITLE: Orientation dependence of the slipping and rupture of single crystals of beryllium on stretching

PERIODICAL: Fizika tverdogo tela, v. 3, no. 4, 1961, 1144-1151

TEXT: The present paper, which is in continuation of earlier investigations, makes a contribution to the clarification of the structural rules of beryllium which is highly anisotropic with respect to its mechanical properties. The single crystals studied were bred from a 99.98% pure starting material, using the method of slow cooling of the melt (crystallization rate: 5 mm/hr). Single crystals of 80 mm length and 60 mm diameter were obtained. The orientation was determined by X-rays. The crystals were cut in different forms by a special electro-spark device, after which they were etched, ground, and polished, first chemically and then mechanically. The tensile tests were made at the following angles to the basal plane: α = 0, 5, 10, 15, 20, 26, 45, 70, and 90° (see Fig. 2). The shearing direction $[11\bar{2}0]$ coincided with one of the lateral faces.

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B102/B214

Orientation dependence ...

The stretching was done at a constant rate of 0.005%/sec at room temperature. The crystallographic elements of plasticity and rupture were studied by crystallographic and microinterference methods. The results of the investigations are illustrated in Figs. 3 and 4. The curve P_{β} (Fig. 3) shows the α-dependence of the ultimate strength. The strongly non-monotonic behavior of this curve contradicts the law of constancy of normal stress on brittle rupture. The curve $P_{2\beta}$ is drawn according to this law and does not represent the experimental facts in any way. The experimental curve $P_{\beta}(\alpha)$ can be described well by the equation $P_{1\beta} = K(\sin^3\alpha\cos\alpha)^{-1/2}$ in the angular range $\alpha = 20\text{-}70^0$, where $K = 3$ kg/mm^2. This equation corresponds to the law $(\tau\sigma)_{destr} = K^2$. However, the experimental results do not correspond to this law between 0 and 15^0. At $\alpha > 20^0$ slipping and rupture occur in the same system of planes, namely, (0001). At $\alpha < 20^0$, the crystallographic elements of plasticity and rupture alter and do not coincide (slipping: $\{10\bar{1}0\}$; rupture: $\{11\bar{2}0\}$). Further, investigations of the structure were made before and after the

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B102/B214

Orientation dependence ...

rupture. The following conclusions are drawn from the results obtained: Highly pure Be single crystals and commercially pure crystals show marked anisotropy in their mechanical properties as well as in the elements of plasticity and rupture on stretching. There is an orientation limit which is characterized by the plasticity at room temperature. The peculiarity of rupture at this orientation is the absence of ideal cleavability and a complicated character of the fracture. Improved plastic properties of polycrystalline Be are obtained by preparing a definite fine-grained texture for which, in the process of deformation, the cleavage in the principal planes of rupture is strongly localized. There are 7 figures and 14 references: 4 Soviet-bloc.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology, AS UkrSSR, Khar'kov)

SUBMITTED: August 1, 1960

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Card 3/5

GARBER, R.I.

34429
S/185/61/006/006/006/030
D299/D304

24.3950

AUTHORS: Harber, R.I., and Kyrylov, V.S.

TITLE: Spectral distribution of optical density of plastically deformed rock-salt crystals

PERIODICAL: Ukrayins'kyy fizychnyy zhurnal, v. 6, no. 6, 1961, 755 - 757

TEXT: The dependence of the intensity of light scattering on wavelength in plastically deformed crystals can be determined by optical-density measurements; thereby the spectrometer СФ-4 (SF-4) was used. The natural rock-salt crystals were annealed at 650 - 700°C and tempered. The optical-density distribution was measured on specimens with a small amount of impurities. Four specimens were measured simultaneously. One of the specimens (which had highest transmittance), was selected as a standard and not subjected to deformation, whereas the other 3 specimens were plastically deformed. Then the optical density was measured with respect to the standard crystal. The results of one of the measurement cycles are shown in a

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Spectral distribution of optical ... S/185/61/006/006/006/030
D299/D304

figure, where the values of lgD + C (D being the optical density and C -- an arbitrary constant) are plotted on the ordinate, and lg λ (λ being the wavelength of the incident light) is plotted on the abscissa. The investigations were carried out for the spectral region 3800 - 6000 Å. The graphs shown are typical for the investigated NaCl crystals. The slope of the straight line $\partial(\lg D)/\partial(\lg \lambda)$ is greater for the deformed crystals, and depends on the size of the scattering particles (inhomogeneities). The increase in the slope is proof of diminishing size of the mosaic blocks. In real crystals, although they were especially selected, and annealed and studied under the same conditions, the development of plastic deformation is not entirely similar; thus, in 2 of the investigated specimens, the slope changed at a stress value of 150 g/mm^2 approximately, whereas in the third specimen -- at 350 g/mm^2 only. Working formulas for a quantitative estimate of the size of the scatterers and their concentration, as a function of optical density, are not available as yet. It is emphasized that the change in the slope starts only at deformation stresses which correspond to the appearance of diffuse scattering (Tyndall's cone) inside the crystal. The

Spectral distribution of optical ... S/185/61/006/006/006/030
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conducted measurements show that it is possible to study the submicrostructure of transparent solids in the early stages of plastic deformation. There are 1 figure and 5 references: 3 Soviet-bloc and 2 non-Soviet-bloc. The references to the English-language publications read as follows: S.P.F. Humphrys-Cwen, Proc. Phys. Soc., B68, no. 6, 325, 1955; R. Fürth, Phil. Mag., 40, 1227, 1949.

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ASSOCIATION: Umans'kyy pedahohichnyy instytut (Uman Pedagogical Institute)

Card 3/3

89943

18.8200

S/126/61/011/001/010/019
E193/E483

AUTHORS: Garber, R.I., Neklyudov, I.M. and Perunina, L.M.

TITLE: Work-Hardening of Bismuth Under Conditions of Programmed Loading

27

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.1, pp.108-114

TEXT: Increasing the rate of deformation, or lowering the temperature, brings about an increase in the work-hardening exponent; this effect is attributed to the fact that under these conditions duration of the relaxation process during deformation decreases. At relatively higher temperatures, the work-hardening exponent decreases owing to increased intensity of relaxation. However, it has been shown by Bol'shanina (Ref.1) that the yield point of twinned calcite increases five times after annealing, while Garber et al (Ref.3) have found that the yield point of iron, twinned at the temperature of liquid helium, also rapidly increases during subsequent heating to room temperature. The object of the present investigation was to elucidate the mechanism of these effects by studying work-hardening of bismuth. Since twinning is

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the predominant mechanism of plastic deformation of this metal, it was assumed that its mechanical properties would be similar to those of twins in calcite and iron. Refined bismuth was used for the preparation of the experimental test pieces, made by the Bridgeman method, in the form of rods (180 mm long, 5 mm in diameter) with spherical ends, and subsequently vacuum-annealed at 200°C for 3 h. The experiments consisted in straining the test pieces in tension at room temperature under controlled conditions. The tensile force was applied by means of weight, hung at the lower end of the specimen, the usual precautions having been taken to ensure axial loading. The load was increased in a pre-determined fashion by means of an automatic dispenser from which small balls dropped at regular intervals into a container which constituted the loading weight. Each load increment did not exceed 6×10^{-3} g/mm^2, and the average rate of loading was maintained constant throughout each experiment, the rates applied varying between 2 and 10 g/mm^2/h. It was found in the course of experiments that it was possible to select a certain critical rate of loading

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$\dot{\sigma}_k$ at which the rate of deformation $\dot{\varepsilon}$ remained constant within a wide interval of applied stress. This can be seen in Fig.2, where elongation ε (10^3%, left-hand scale) and stress σ (g/mm^2, right-hand scale) are plotted against time t (hours). To make sure that the test piece had, in fact, undergone plastic deformation, ε was measured while the load was gradually removed. The results (broken curves in Fig.2) show that although some elastic recovery had taken place, more than a half of the elongation, attained at the end of the loading cycle, was due to plastic deformation. Fig.3 shows two $\sigma(\varepsilon)$ curves, constructed for two identical specimens, loaded at $\dot{\sigma} < \dot{\sigma}_k$, the upper and lower graphs relating to specimens loaded at 2.3 and 4.5 g/mm^2/h, respectively. It will be seen that in both cases, the work-hardening exponents $\partial\sigma/\partial\varepsilon$ remained constant. The results of the next series of experiments are reproduced in Fig.4, where elongation ε (%, left-hand scale) and stress σ (g/mm^2, right-hand scale) are plotted against time t (hours). Graph 1, $\sigma(t)$ and 2, $\varepsilon(t)$ relate to a specimen tested in the following way:

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the load was applied at a rate $\dot{\sigma} = 8$ g/mm^2/h until a certain σ_m was reached at which the $\varepsilon(t)$ relationship ceased to be linear; beginning from this moment, the load was maintained constant at σ_m for 24 h during which time the test piece continued to deform owing to creep; the rate of creep during this period remained constant and was practically the same as the rate of strain during the preceding period. For comparison, Fig.4 shows a creep curve (graph 3) of another specimen which has been loaded to σ_m in 20 min. It will be seen that in this case the total deformation was higher than that of the test piece strained under slow rate of loading, and that the rate of creep under this constant stress σ_m was also considerably higher. The interesting fact is that in the case of specimens, work-hardened during deformation at slow rate of loading and then re-loaded at a fast rate to σ_m, the rate of creep decreased 2 to 3 times (see right-hand branch of graph 2, Fig.4). It was also found that test pieces, work-hardened by deformation at slow loading rates, did not lose their strength after ageing (with the load taken off) at room temperature. The results described above confirm the hypothesis put forward by Garber (Ref.4),

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according to whom the observed effects are due to diffusion strengthening of twins which is brought about by aggregation of vacancies and impurity atoms at the twin boundaries. In cases when twins do not traverse the cross-section of the test piece, diffusion strengthening may inhibit further growth of the twins even at relatively high loads. It was for this reason that no traces of twins were observed on the surface of the test pieces used in the experiments described above and that deformation took place under conditions of equilibrium, as indicated by the absence of discontinuities on the $\varepsilon(t)$ curves. Different results were obtained when a test piece in the form of a single crystal, 1.2 mm in diameter, was used. This is illustrated by graphs in Fig.5, where $\Delta \ell$ (microns, left-hand scale) and σ (g, right-hand scale) are plotted against time t (hours). Sudden jumps on the $\Delta \ell(t)$ curve for a test piece under load which increased at a constant rate indicate that work-hardening, caused by diffusion-induced enrichment of the twin boundaries in vacancies and impurity atoms, cannot prevent the formation and growth of twins in a specimen of

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this size. In the case of high quality single crystals of small cross-section area, a twin nucleus (e.g. an elastic twin) can rapidly change into a twin intersecting the cross-section of the specimen, as a result of which deformation of the specimen proceeds in jumps, since the resistance to deformation (by twinning) at the moment of the formation of a twin decreases several times. The $\Delta \ell(t)$ and $\sigma(t)$ curves for such a specimen (a single crystal with the gauge length of 150 mm and rectangular cross-section 3 x 2.5 mm) are shown in Fig.6. In spite of very slow rate of loading employed, it was found impossible to obtain gradual deformation (i.e. smooth $\Delta \ell(t)$ curves) of the specimens, on the surface of which evidence of twins, intersecting the cross-section, was found after completion of the loading cycle. That these effects were observed in a rectangular specimen can be attributed to non-uniform distribution of stresses over its cross-section and to the high quality and homogeneity of its crystal structure. Finally, in order to elucidate the nature of the processes leading to work-hardening of specimens deformed at slow and fast rates of
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loading, X-ray diffraction patterns of test pieces, loaded to the same σ_m (yield point) but at different rates of loading (8 and 1080 $g/mm^2/h$), were obtained. The pattern obtained for the slowly loaded specimen hardly differed from that obtained for an undeformed material, whereas a very different pattern was obtained on the specimen deformed at a fast rate of loading. This indicated that work-hardening under normal conditions of loading (within the elastic region) is associated with fragmentation of the crystal, whereas all other factors being equal, deformation under conditions of slow rates of loading does not affect the crystal structure or affects it only in the regions of lowest strength which constitute a minute fraction of the total volume of the crystal. Acknowledgments are made to I.M.Fishman and S.T.Shavlo, who participated in this work. There are 9 figures and 11 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR
(The Physicotechnical Institute AS UkrSSR)

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Work-Hardening of Bismuth Under Conditions of Programmed Loading

SUBMITTED: May 25, 1960

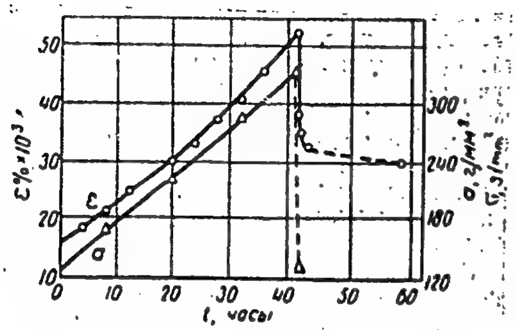

Рис. 2. Графики σ(t) и ε(t) при программном нагружении.

Fig.2.

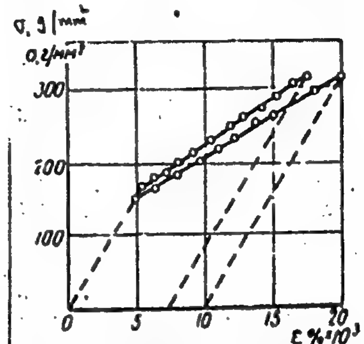

Рис. 3. Упрочнение образцов висмута при программном нагружении.

Fig.3.

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Work-Hardening of Bismuth Under Conditions of Programmed Loading

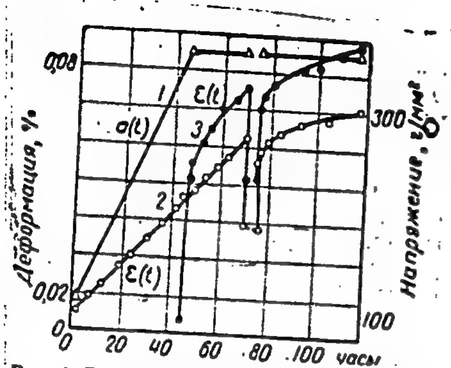

Рис. 4. Графики $\sigma(t)$ и $\varepsilon(t)$ при программном и быстром нагружении образцов висмута до напряжения σ_m.

Fig.4.

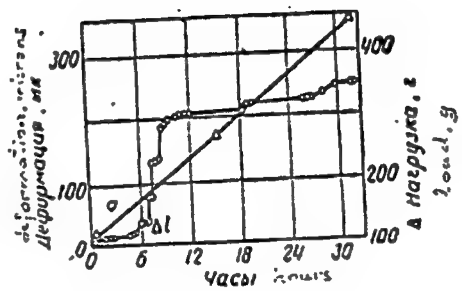

Fig.5.

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Work-Hardening of Bismuth Under Conditions of Programmed Loading

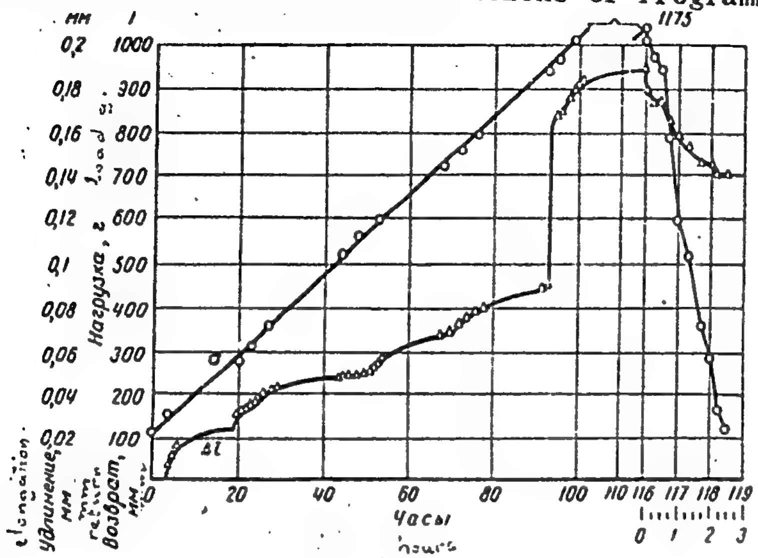

Fig.6.

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22964
S/126/61/011/005/009/015
E193/E183

AUTHORS: Garber, R.I., and Polyakov, L.M.

TITLE: Investigation of the process of sintering metals. II.

PERIODICAL: Fizika metallov i metallovedeniye, Vol.11, No.5, 1961, pp. 730-740.

TEXT: Part I of this paper was published in the Ukr.Fiz.Zh., 1956, Vol.1, 88.
The process studied by the present authors consisted in butt-joining two flat, ring-shaped aluminium specimens by simultaneous application of heat and pressure and constituted, in fact, pressure welding. The object of the present investigation was to study the relationship between the strength of joints, produced by this method, and the pressure employed, temperature, and duration of the process. In addition, the variation of the microstructure near the joint interface was studied, and the temperature dependence of hardness of aluminium was determined. To minimise the effect of oxide films and gases absorbed on the metal surface, all experiments were carried out in vacuum of 10^{-5} to 10^{-6} mm Hg.
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Investigation of the process of sintering metals. II.

Immediately before each experiment, the surfaces to be joined were cleaned with a steel brush after which the surface roughness was 0.5-1.5 μ. The two rings were then assembled in a specially designed press, the whole was placed in the vacuum changer, the temperature of the aluminium rings was raised to 600 °C and kept constant for 15-20 minutes, after which they were cooled to the test temperature and the appropriate load applied. The strength of the joint was determined on a tensile testing machine. The results are reproduced graphically. In Fig.4, U.T.S. (σ_p, kg/mm^2) of the joint obtained under pressure $p = 0.32$ kg/mm^2, is plotted against the sintering time (τ, minutes), curves 1-4 relating to sintering at 450, 500, 550 and 600 °C respectively. A similar set of curves, constructed for joints obtained under $p = 2$ kg/mm^2, is reproduced in Fig.5. In Fig.6, σ_p is plotted against p (kg/mm^2), curves 1-6 relating to joints obtained at 300, 400, 450, 500, 550 and 600 °C respectively. It was inferred from these results that the process studied takes place in two stages. The first stage consists in the formation of metallic bond between the
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Investigation pf the process of sintering metals. II.

clean surfaces brought into intimate contact by the action of the applied pressure. The strength of the resultant joint is determined mainly by the conditions obtaining during this initial stage. It is pointed out here that for the joint to be formed, it is not only necessary to bring the two mating surfaces within a distance equal to the lattice parameter of the metal, but a re-grouping of the atoms has also to take place in order to create conditions favourable for the formation of the metallic bond. The activation energy for the re-grouping of atoms in aluminium has been found to be 6.4 kcal/mol. In the second stage of the process, in which diffusion plays the predominant part, the areas of contact established during the first stage increase as a result of: (1) movement of vacancies to the boundaries of the welded regions; (2) coalescence of the excess vacancies and formation of large pores due to dissolution of small pores; and (3) dissolution of large pores. The effect of the second stage of the process on the strength of the resultant joints becomes significant only at high temperatures and after a prolonged sintering.

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22964
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Investigation of the process of E193/E183

There are 10 figures and 16 references: 8 Soviet and 8 non-Soviet. The English language reference reads:
Ref.7: G.J. Finch and R.T. Spurr. Physics of Lubrication, Supplement, 1951, No.1.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR g. Khar'kov (Physico-technical Institute, AS Ukr.SSR, Khar'kov). X

SUBMITTED: August 15, 1960

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24477

S/126/61/011/006/003/011
E193/E483

21.2100

AUTHORS: Garber, R.I., Zalivadnyy, S.Ya. and Mikhaylovskiy, V.M.

TITLE: Variation of the microstructure of uranium during cyclic thermal treatment. II

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.6, pp.889-892

TEXT: This is a continuation of earlier published work of the authors (Ref.1: FTT, 1960, 2, 6, 1052 and Ref.2: FMM, 1959, 8, 904) relating to the mechanism of distortion of uranium during thermal cycling on bi-crystal specimens and on coarsely crystalline material with columnar grains. In this paper the authors investigate the laws governing the thermal cycling-induced changes in finely-crystalline technical grade uranium. To ensure uniform grain-size of the required magnitude, cylindrical uranium specimens (60 mm long, 8 mm in diameter) were annealed and then compressed (in the direction normal to the axis) to approximately 50% reduction in thickness and the resultant blanks were machined to produce prismatic specimens measuring 60 x 4 x 3 mm. After recrystallization, these specimens were plastically deformed in

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compression (8% reduction in thickness) in the direction normal to the longitudinal axis and to the direction of the first compressing operation; this was done to develop texture in the material studied. The specimens were then cut into several prismatic test pieces which, after polishing (mechanical and electrolytic) and recrystallization, measured 6 x 2.5 x 1.5 mm. On 3 faces of each test piece a set of lines, spaced at 0.1 mm intervals, was inscribed by making scratches 2 μ wide and 0.5 μ deep. Annealing, recrystallization and the thermal cycling tests were all carried out in vacuum of 5×10^{-6} mm Hg. Each thermal cycle consisted of the following: heating to 600°C in 5 minutes; holding at 600°C for 1 minute; cooling to 100°C in 4 minutes. The specimens (whose original grain size was 25 μ) were examined after 200, 400, 600, 800, 1300 and 2000 cycles. The dimensional changes of several test pieces after 600 cycles are tabulated. It will be seen that the length of the test pieces increased, their width and thickness decreased. Metallographic examination revealed that thermal cycling had brought about both the deformation in the interior of the grains and relative displacement of the grains. The latter effect was reflected in increased roughness of the

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Variation of the microstructure ... E193/E483

surface of the test pieces. This is illustrated in Fig.3 showing ($\times 200$ and $\times 200\sqrt{2}$ in the horizontal and vertical direction, respectively) the contour of the surface of a specimen (a) before thermal cycling, (б) after 600 cycles and (в) after 2000 cycles. The average grain-size of the specimens decreased from the initial 25 μ to 18 μ after 2000 cycles. The rate of increase in the length of the test pieces increased with the increasing number of the cycles, $\Delta l/l$ per 1 cycle after 2000 cycles being 2 to 3 times larger than that after 600 cycles. After 2000 cycles the length of the test pieces increased on the average by 60%; at the same time the average increase in length of the grains was 20%. This discrepancy was attributed to the effect of recrystallization taking place during thermal cycling on the total elongation of the grains. There are 5 figures, 1 table and 4 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR
(Physico-technical Institute AN UkrSSR)

SUBMITTED: September 27, 1960

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APPROVED FOR RELEASE: 07/19/2001 CIA-RDP86-00513R000514320001-5"

30456

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S/126/61/012/003/016/021
E193/E135

AUTHORS: Garber, R.I., Gindin, I.A., and Shubin, Yu.V.

TITLE: Tensile tests on beryllium single crystals in the 20-500 °C temperature range. V.

PERIODICAL: Fizika metallov i metallovedeniye, vol.12, no.3, 1961, 437-446

TEXT: Scarcity of data on the behaviour of beryllium single crystals under tensile stresses prompted the present authors to undertake the study of this subject. The experimental specimens were prepared from 99.98% pure Be by a pulling-out technique. The orientation of the single crystal tensile test pieces is shown in Fig.1, where p indicates the direction of the applied stress. A strain rate of 0.005%/sec was used in the tensile tests carried out at 20, 200, 400 and 500 °C, helium being employed as the protective atmosphere at elevated temperatures. The mechanical tests were supplemented by metallographic examination. The results of the mechanical tests are reproduced graphically. In Fig.2, the UTS and the yield point (p_b and p_s, kg/mm^2, left-hand scale)

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Tensile tests on beryllium single ... S/126/61/012/003/016/021
E193/E135

and elongation and reduction of area (δ and ψ, %, right-hand scale) are plotted against the test temperature (°C). The fifth curve shows the temperature-dependence of the so-called "diffusion deformation" factor, χ, which is given by $\chi = (1 - \varphi)\ 100$ °C, where φ denotes the deformation localised in the slip on the basal plane, its magnitude being calculated from

$$\varphi = \frac{\sum_i n_i a_{si}}{(\Delta \ell)_s}$$

where n_i is the number of basal slip bands with the absolute slip displacement of a_{si}, and $(\Delta \ell)_s = \Delta \ell \cos 45°$ represents the strain of the specimen in the direction of slip. Fig.2 shows the true tensile stress/elongation curve for beryllium single crystals at temperatures indicated by each curve. The effect of temperature on the mode of slip is illustrated in Fig.4, showing (X 200) slip lines on the faces of specimens extended (from left to right) at 20, 200 and 400 °C. The variation of the mode of slip with rising temperature was also studied by determining the magnitude of the

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Tensile tests on beryllium single S/126/61/012/003/016/021
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relative slip, γ, and density of the slip bands, ρ, these two parameters being given by $\gamma = b/a_s$ and $\rho = 1/h$ (for the meaning of b/a_s and h see Fig.1). In the regions of uniformly distributed slip lines, γ increased from 0.4 at 20 °C to 2.0 at 500 °C; in the region of macroscopically localised slip, at 400 °C, γ reached 70. The parameter ρ also initially increased with temperature, reaching a maximum of 0.12 1/μ at 200 °C after which it decreased again, reaching at 400-500 °C a value similar to that at room temperature (~ 0.3 1/μ). Analysis of the results of mechanical tests, correlated with the examination of slip bands and microstructure of specimens after fracture, led to the following conclusions. 1) Plasticity of Be single crystals increases monotonically with rising temperature, showing no peak at 400 °C which is a characteristic of polycrystalline beryllium. The increase in plasticity in the 20-200 °C range is caused by the formation of new slip bands with the material within the bands hardening at a sufficiently fast rate. The increase in plasticity at higher temperatures is associated with the onset of localised slip, characterised by a

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Tensile tests on beryllium single ...

large magnitude of γ (about 70). Both UTS and the so-called strain-hardening modulus $\overline{D}$ passed through a maximum at 200 °C; $\overline{D}$ is given by $\overline{D} = (p_u - p_s)\delta$, where p_u is the true UTS of the metal. This effect is a manifestation of the simultaneously occurring processes of strain-hardening and relaxation.
2) Deformation of Be single crystals with an orientation as illustrated in Fig.1 takes place mainly by slip along the basal planes (0001) in the [11$\bar{2}$0] direction. At higher temperatures, prismatic slip along the {101X} plane in the general [11$\bar{2}$0] direction and diffusion deformation play an increasingly important part. 3) Brittleness of Be single crystals at room temperature is caused by non-uniform plastic deformation along the basal plane which causes the formation and growth of cracks along the main cleavage plane. At high temperatures, slip becomes more uniform and deformation takes place partly by prismatic slip.
There are 10 figures, 1 table and 1 Soviet-bloc reference.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Physicotechnical Institute, AS Ukr.SSR)

SUBMITTED: January 2, 1961

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S/053/61/074/001/001/003
B117/B212

AUTHORS: Garber, R. I., and Gindin, I. A.

TITLE: Physical properties of high-purity metals

PERIODICAL: Uspekhi fizicheskikh nauk, v. 74, no. 1, 1961, 31 - 60

TEXT: The present survey deals with papers which have been published in recent years in the field of high-purity metals. The papers show a trend to obtain specimens of ever-increasing purity. They also show that the progress made varies for different metals (appendix). The physical problems associated with such metals are discussed, for whose analysis the purity of the specimens is decisive. These problems include the electrical resistance, the reflectance of the metals, the magnetic permeability, nuclear reactions, effects of radioactive irradiation, grain boundaries, latent energy of plastic deformation, relaxation, recrystallization, internal friction, moduli of elasticity,and mechanical properties. The latter include the plasticity, deformation curve, cold-brittleness and creeping. A glance at the material available shows that great progress has been made in the analysis of high-purity metals. The most urgent task at present
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seem to be to develop methods for industrial production of these metals. So far, it has been impossible to solve the problem concerning the changes of physical properties of metal effected by small additions. Regarding the electrical resistance, the joint effect of local distortions by foreign atoms and other causes, such as vacancies etc., may be considered to be proved. The mechanical properties are very sensitive toward additions, especially with respect to structural changes occurring during crystallization or other thermal processes. Vacancies and local distortions seem to play a minor role only. The brittleness of various metals can be eliminated by purifying them from additions. A further development of new methods for the separation of metals will find new fields of application for high-purity metals. References to publications on high-purity metals are given for the following elements: Al, Ba, Be, V, W, Bi, Ga, Ha, Fe, Au, In, Cd, Ka, Ko, Mg, Mn, Cu, Mo, Ni, Nb, Pt, Sn, Pb, Ag, Sr, Sb, Ta, Ti, Th, U, Cr, Zn, and Zr. The following Soviet authors are mentioned: L. S. Kan, B. G. Lazarev (Ref.1: DAN SSSR 81, 1027 (1951); V. B. Zernov, Yu. V. Sharvin (Ref.7: ZhETF 36, 1038 (1959); B. N. Aleksandrov, B. I. Verkin (Ref.8: ZhETF 34, 1655 (1958); A. I. Sudovtsov, Ye. Ye. Semenenko (Ref.18: ZhETF

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35, 305 (1958); I. M. Lifshits, M. I. Kaganov (Ref.29: UFN 69, 419 (1959); B. Leks (Ref.30: UFN 70, 111 (1960); A. S. Zaymovskiy, G. Ya. Sergeyev, V. V. Titova, B. M. Levitskiy, Yu. N. Sikurskiy (Ref.34: Atomnaya energiya 5, 412 (1958); M. Ya. Gal'perin, Ye. P. Kostyukova, B. M. Rovinskiy, Izv. AN SSSR, ser. tekhn. 4, 82 (1959); D. Ye. Ovsiyenko, Ye. I. Sosnina, (Ref. 60: Voprosy fiziki metallov i metallovedeniya, sb. no. 9, Kiyev (1959) str. 185); V. A. Pavlov (Ref.64: Fiz. metallov i metallovedeniye 4, 1 (1957); V. A. Zhuravlev, (Ref.72: Zavodskaya laboratoriya 14, 687 (1959); V. S. Yemel'yanov, A. I. Yevstyukhin, D. D. Abonin, V. I. Statsenko, ("Metallurgiya i metallovedeniye chistykh metallov" vyp. 1, 1959, 44). There are 18 figures, 7 tables, and 144 references: 61 Soviet-bloc and 83 non-Soviet-bloc. The six references to English-language publications read as follows: D. J. Maykut, Prod. Engineering 24, 186 (1953) - (Ref.31); A. N. Holden, Phys. Metal. of Uranium Massachus., 1958, str. 7 (Ref.33); J. C. Blade, Rev. metallurgie 54, 769 (1957) (Ref.50); P. Gordon, J. Metals 7, 1043 (1955); (Ref.51); C. Zener, Phys. Rev. 74, 639 (1948) (Ref.68); T. R. Barrett, G. G. Ellis, R. A. Knight, Proc. Sec. Int. Conf. Geneva 5, 319, 320 (1958) (Ref. 100).

GARBER, R.I.; KIRILLOV, V.S.

Change in the spectral distribution of optical density caused by light scattering in plastic deformation of rock salt crystals. Kristallografiia 7 no.1:142-144 Ja-F '62. (MIRA 15:2)

1. Umanskiy gosudarstvennyy pedagogicheskiy institut.
(Rock salt—Optical properties)

GARBER, R.I.; STEPINA, Ye.I.

Defects at stopping places of twins' boundaries. Kristallografiia 7 no.2:325-326 Mr-Ao '62. (MIRA 15:4)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Crystals--Defects)

GARBER, R.I.; MOGIL'NIKOVA, T.T.

Determining the elasticity limit of real solids. Fiz. met. i metalloved. 13 no.2:314-316 F '62. (MIRA 15:3)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Solids) (Elasticity)

S/126/62/013/005/014/031
E073/E535

AUTHORS: Garber, R.I. and Mogil'nikova, T.T.

TITLE: Internal friction and plastic deformation of overloaded micro-regions of a solid body. II

PERIODICAL: Fizika metallov i metallovedeniye, v.13, no.5, 1962, 735-737

TEXT: The effect of increasing stresses during repeated tests was studied on lead and tin at room and at liquid nitrogen temperatures. In earlier work (DAN SSSR, 1958, 118, No.3) the authors showed that application of additional, monotonously increasing, stresses in the case of elastic, freely damped, oscillations, which leads to an appreciable increase in the internal friction, will also lead to the damping decrement showing a specific dependence on the stress increase $dp/dt = \alpha$, the amplitude β and the frequency ν. The rate of stress increase from which the damping decrement is saturated, α_{cr}, can be expressed by the experimentally verified proportionality relation

$$\alpha_{cr} \sim \nu\beta \qquad (1)$$

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To improve the accuracy of relation (1), the intensity of the tangential stresses τ_i is applied which, for a tube stressed by internal pressure ($p = \alpha t$) and by a torque causing shear stresses σ_{12}, can be expressed by

$$\tau_i = \frac{\sqrt{2}}{3}\sqrt{A\alpha^2 t^2 + 3\beta^2 \sin^2 \omega t + \sigma_o^2} \qquad (2)$$

where

$$A = \frac{3}{4} \frac{r_{av}^2}{h^2}; \qquad (3)$$

σ_o is the constant component of the tensile stresses occurring under the effect of the applied load. Analysis of this relation shows that the intensity of tangential stresses characterizes satisfactorily the plastic deformation in over-loaded micro-volumes. Recrystallization cannot be the cause of the observed effect of increasing stresses on the damping decrement, which decreases during repeated tests after short pauses. Very short (30 sec) pauses will not re-establish the initial properties of these regions for which at room temperature pauses of 15 min are required for lead and 40 min for tin. There are 4 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physico-technical Institute AS UkrSSR)

SUBMITTED: May 22, 1961

S/032/62/028/001/014/017
B116/B108

AUTHORS: Garber, R. I., Gindin, I. A., Neklyudov, I. M., Chechel'nitskiy, G. G., and Stolyarov, V. M.

TITLE: Device for programmed metal hardening

PERIODICAL: Zavodskaya laboratoriya, v. 28, no. 1, 1962, 107 - 109

TEXT: A device has been designed for programming the load on samples. It permits determining the effect of the charging rate on the material properties up to 800°C in a vacuum of 10^{-6} mm Hg or in inert gases. The charging rate can be increased from 10 g/mm^2 per hr to 3 kg/mm^2 per hr. Moreover, rates of up to 80 kg/mm^2 per hr are possible. The maximum load is 350 kg. The sample elongation (up to 4 - 5 mm with an error of 0.5 μ) is measured with an optical strain gauge. Reduction of the charging rate to values corresponding to diffusion hardening lowers both the total deformation and the rate of steady creep. The device (Fig. 1) operates as follows: Dynamometer spring (6) is compressed by the reducing gear (7). The charging rate is regulated by varying the periodic operation of the motor (8) (РД-09 (RD-09)-type) driving the gear

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S/032/62/028/001/014/017
Device for programmed metal hardening B116/B108

(7). The sample is heated by a tubular furnace with molybdenum coil, and the temperature is regulated by an ЭПД-12 (EPD-12) electronic potentiometer. There are 4 figures and 6 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk USSR (Physico-technical Institute of the Academy of Sciences UkrSSR)

Fig. 1. Diagram of device for programmed hardening.
Legend: (1) sample; (2) and (3) fastenings; (4) cross piece; (5) three bars; (6) dynamometer spring; (7) reducing gear; (8) motor; (9) ball-bearing joint; (10) indicator; (11) mains connection; (12) base plate; (13) vacuum chamber; (14) sylphon; (15) limiter; (16) to pump.

GARBER, R.I.; GINDIN, I.A.; CHIRKINA, L.A.

Twinning and annealing of nonequilibrium iron-nickel alloy of the Sikhote-Alin iron meteorite. Meteoritika no.23:45-55 '63. (MIRA 16:9)

(Sikhote-Alin Range—Meteorites)

ACCESSION NR: AR4041609 S/0137/64/000/005/I049/I049

SOURCE: Ref. zh. Metallurgiya, Abs. 5I289

AUTHOR: Garber, R. I.; Soloshenko, I. I.

TITLE: Accumulation of microdefects during elastico-plastic reverse bend

CITED SOURCE: Sb. Relaksats. yavleniya v met. i splavakh. M., Metallurgizdat, 1963, 80-84

TOPIC TAGS: microdefect, crystal, elasticoplastic bend, reverse bend

TRANSLATION: On special installation, a diagram and description of which are given, regularities are studied of accumulation in transparent crystals during elastico-plastic bend of the dislocations and defects scattering light, and the influence of accumulation of defects on internal friction. Working frequency of forced oscillations of samples amounted to ~1 cps. Integral light scattering was determined on electronic installation with FEU-18A photomultiplier. Intensity of light scattering was measured with motionless sample — during stops of pendulum.

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ACCESSION NR: AR4041609

Single crystals of NaCl and LiF, preliminarily annealed at 65° for 40 and 25 hours, respectively were investigated. Amplitude of stress amounted to 200 g/mm^2. Obtained curves of dependency of damping decrement δ and magnitude of photocurrent (transparency) I from number of bend oscillations of sample N show that with growth of N magnitude δ decreases (which is accompanied by decrease of sag and increase of number of slip bands), I also decreases, that is, integral scattering of white light is increased. Saturation in change of given properties is observed after 10^4 cycles. During stops and holding of crystal without load there occurs partial restoration of transparency at constant value of δ. It is assumed that such rest, not removing work hardening, leads to partial restoration of contacts between fragments formed in process of cyclical deformation. For crystals of LiF values of δ and I with growth of N also decrease; besides in all cases moment of saturation for δ sets in somewhat faster than for I. Metallographic analysis confirmed that reverse deformation with limited amplitude of stresses leads to accumulation of defects and increase of dislocations and slip bands; with this saturation of hardening occurs with smaller number of cycles than process of dispersion.

SUB CODE: SS, MM ENCL: 00

Card 2/2

S/181/63/005/001/032/064
B102/B186

AUTHORS: Garber, R. I., and Stepina, Ye. I.

TITLE: Mechanism of mixing of dislocations during elastic twinning

PERIODICAL: Fizika tverdogo tela, v. 5, no. 1, 1963, 211 - 219

TEXT: Formation and variation of elastic twins in calcite crystals was investigated by photographing and photometrizing the transmission interference patterns. The elastic twins were created by pressing a steel ball against a crystal face. Length and thickness of the wedge-shaped twins were proportional to the load. The creation of the twin and its growth depended greatly on the stress distribution inside the crystal, i. e. not only on the load but also on the ball radius. Balls of different dimensions but impressed with equal loads yielded twins of different length and thickness; the greater the ball diameter the shorter the twin; twins of equal length were thinner when produced by a larger ball. When changing from loading to unloading, or vice versa, the twinning process shows a hysteresis effect with respect to the twin length. This effect is due to the change in sign of the dislocation friction forces (Peierls forces) when changing from
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Mechanism of mixing of ... S/181/63/005/001/032/064
B102/B186

loading to unloading. The kind of hysteresis depends on the ratio between Peierls forces and surface tension. In calcite the Peierls forces are rather weak. The length of the hysteresis region decreases with the twin length and it vanishes at 0.1-0.2 mm twin length. The rules governing shape and growth of elastic twins depend uniquely on the dislocation distribution along the twin and this distribution is determined by the crystal defects and the Peierls forces. There are 7 figures.

SUBMITTED: July 28, 1962

Card 2/2

GARBER, R.I.; GINDIN I.A.; SHUBIN, Yu.V.

Compression of beryllium single crystals along the hexagonal axis in the temperature range 4.2° to 900° K. Fiz. tver. tela 5 no .2: 434-442 F '63. (MIRA 16:5)
(Beryllium crystals) (Strength of materials)

GARBER, R.I.; STEPINA, Ye.I.

Strengthening of calcite following multiple twinning. Fiz. tver tela 5 no.9:2656-2662 S '63. (MIRA 16:10)

GARBER, R.I.; STEPINA, Ye.I.

Defects due to the fusion of the interlayers of a polysynthetic twin. Fiz. tver. tela 5 no.12:3489-3495 D '63. (MIRA 17:2)

GARBER, R.I.; GINDIN, I.A.; STOLYAROV, V.M.; CHECHEL'NITSKIY, G.G.; CHIRKINA, L.A.

Apparatus for studying the damping of low-frequency torsional oscillations. Prib. i tekh. eksp. 8 no.3:172-174 My-Je '63. (MIRA 16:9)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.
(Oscillations--Electromechanical analogies)

S/126/63/015/003/022/025
E073/E320

AUTHORS: Garber, R.I., Gindin, I.A. and Neklyudov, I.M.

TITLE: Influence of "programmed strengthening" on the creep and recrystallization of iron at elevated temperatures

PERIODICAL: Fizika metallov i metallovedeniye, v. 15, no. 3, 1963, 473- 475

TEXT: In earlier investigations on calcite, bismuth and iron, the authors found that in addition to ordinary strengthening caused by lattice distortions during the process of plastic deformation under a continuous load, there is also "programmed strengthening" due to diffusion-blocking and strengthening of weak and overloaded lattice nodes. This produces an increase in the yield point, plasticity at low temperatures and an increased creep resistance. So far, an improvement in the mechanical properties has been observed only at temperatures lower than or equal to the temperature of the programmed treatment. In the work described here, specimens of Fe (0.03% C) were polished and chemically etched, vacuum-annealed at 880 °C for 3 hours and then slowly cooled. After "programmed loading" up to 8 kg/mm^2 at 300 °C at
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a rate of 90 $g/mm^2/h$, the specimens were subjected to a 100-hour creep test at 400 °C with a load of 7 kg/mm^2. The creep rate of previously program-loaded specimens was significantly lower (about 5.6 x 10^{-3} %/h) both in the initial and in the steady-state stages) than that of specimens to which the final load had been applied quickly (1.3 x 10^{-2} %/h in the steady-state section). This indicates that overloading does not eliminate the effect of increased resistance to creep of program-strengthened specimens. Microstructures are reproduced of both types of specimens after annealing at 830 °C for 3 hours: of specimens loaded at 400 °C with a load increasing to 16 kg/mm^2, whereby the rate of increase varied between 220 and 6 x 10^5 $g/mm^2/h$; of specimens loaded quickly. The residual deformations were 1.3 and 1.6%, respectively. The microstructure of specimens which were subjected directly to the final load showed signs of selective recrystallization, whilst the microstructure of the program-loaded specimens was almost the same as prior to annealing. The authors consider the results as a further proof that program-loading leads to a more

equilibriated stable structure in that the strengthening does not seem to be accompanied by an increase in the free energy of the crystal. There are 3 figures.

SUBMITTED: August 15, 1962

L 18049-63 EWP(q)/EWT(m)/BDS AFFTC/ASD JD

ACCESSION NR: AP3002850 S/0126/63/015/006/0908/0913

AUTHORS: Garber, R. I.; Gindin, I. A.; Neklyudov, I. M.

60
57

TITLE: Programmed hardening of commercial iron

SOURCE: Fizika metallov i metallovedeniye, v. 15, no. 6, 1963, 908-913

TOPIC TAGS: programmed hardening, iron, mechanical property

ABSTRACT: One of the possible methods for improving mechanical properties of solid bodies consists of diffusive blocking and strengthening of weak or over-stressed parts of a specimen. Such parts may develop shearing, sliding surfaces, twinning bands, or dislocation sources. This method was called "the programming of hardening." The device used in the programming procedure is described. It allows the stretching of a specimen at high temperatures and at very small rates of load increase. The commercial iron samples that underwent a programmed hardening at 200C were studied. The tensile test was conducted at the temperature of liquid nitrogen and also at room temperature. The creep test was also conducted at 200C. Preliminary deformation at high temperatures and low rates of loading resulted in: 1) increase of flow limit and hardening modulus; 2) increase in plasticity at the temperature of liquid nitrogen; 3) a substantial decrease in creep velocity;

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L 18049-63

ACCESSION NR: AP3002850

3

4) elimination of creep at 3000. It is concluded that the observed effects are due to a diffusive hardening of weak and overstressed regions in the samples. The authors express their appreciation to V. M. Stolyarov and G. G. Chechel'nitskiy for their help in the construction of this device. Orig. art. has: 6 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Institute of Physics and Technology, Academy of Sciences, UkrSSR)

SUBMITTED: 26Jun62 DATE ACQ: 23Jul63 ENCL: 00

SUB CODE: ML NO REF SOV: 008 OTHER: 001

Card 2/2

KRISHTAL, Mikhail Aronovich; PIGUZOV, Yuriy Vasil'yevich; GOLOVIN Stanislav Alekseyevich; GARBER, R.I., prof., retsenzent

[Internal friction in metals and alloys] Vnutrennee trenie v metallakh i splavakh. Moskva, Izd-vo Metallurgiia, 1964. 245 p. (MIRA 17:6)

GARBER, R.I.; STEPINA, Ye.I.

Secondary cleavage in calcite crystals. Kristallografiia 9 no.2:255-259 Mr-Ap'64. (MIRA 17:5)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.

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GARBER, R.I.; GINDIN, I.A.; MOGIL'NIKOVA, T.T.; NEKLYUDOV, I.M.

Internal friction of iron hardened by programming. Fiz. met. i metalloved. 18 no.3:443-447 S '64. (MIRA 17:11)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.

L 36625-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(k)/EWP(b)/EWA(c) IJP(c) JD/HW
ACCESSION NR: AP5002348 S/0126/64/018/006/0904/0908

AUTHOR: Garber, R. I.; Gindin, I. A.; Zalivadnyy, S. Ya.; Mikhaylovskiy, V. M.; Malik, A. K.; Steklyudov, I. M.

TITLE: Effect of programmed hardening on creep of polycrystalline zinc and stability during cyclic heat treatment

SOURCE: Fizika metallov i metallovedeniye, v. 18, no. 6, 1964, 904-908

TOPIC TAGS: polycrystalline zinc, creep, programmed hardening, heat treatment, cyclic heat treatment

ABSTRACT: The effect of programmed hardening (hardening by controlled application of stress at slow rates) on the creep of polycrystalline zinc at room temperature and on its resistance to forming during cyclic heat treatment was studied. The linear deformation of annealed polycrystalline zinc and of samples subjected to loading ($1-6 \times 10^{-4}$ kg/mm^2/min) and to loading beyond the yield point (2.5 kg/mm^2/min) was compared. The elongation of the programmed samples

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L 36625-65

ACCESSION NR: AP5002348

2

was less than in the annealed and rapidly stressed samples; was reduced two times as the programmed rate was decreased from 5 to 1.5 x 10^{-4} kg/mm^2. Samples subjected to normal treatment were less resistant to heating-cooling cycles than programmed samples. The hardening increased as the maximum temperature of the cycle was reduced. The maximum temperature approached the melting temperature (0.9T_m K). The creep in program hardened samples was less than in those otherwise deformed. Metallographic analysis showed slip bands and the formation of substructures in a small number of the grains. Small migration of the boundaries occurred in samples after programmed and after ordinary hardening prior to thermal cycling; after that the migration in the programmed samples was much less noticeable. Thus programmed hardening of polycrystalline zinc increased its creep strength and its resistance to forming during cyclic heat treatment. Orig. art. has: 3 figures and 1 table

ASSOCITTION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physical-technical Institute AN UkrSSR)

SUBMITTED: 01Aug63 ENCL: 00 SUB CODE: MM

NR REF SOV: 009 OTHER: 001

Card 2/2

ACCESSION NR: AP4043067 S/0053/64/083/003/0385/0432

AUTHORS: Garber, R. I.; Fedorenko, A. I.

TITLE: Focusing of atomic collisions in crystals

SOURCE: Uspekhi fizicheskikh nauk, v. 83, no. 3, 1964, 385-432

TOPIC TAGS: crystal lattice structure, fast particle, radiation damage, particle collision, cathode sputtering, ion bombardment

ABSTRACT: The authors have systematized and explained as far as possible the theoretical treatments of the mechanism of atom focusing occurring in a crystal lattice when solid materials are bombarded by fast particles, and bring together the main experimental results reported in the literature. Each of the theories recently developed for the formation of radiation damage in solid materials (cascade displacement of atoms, thermal spikes, displacement zones, and others) is analyzed briefly and its advantages and shortcomings compared.

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The study of atomic collision focusing, whereby bombardment of a crystal by a charged or neutral particle results in preferential propagation of a wave of atomic collisions along the most closely packed directions, under the influence of the regular location of the atoms in the lattice to various branches in physics is outlined. It is shown to be important not only to investigations of radiation damage, but also in connection with studies of cathode sputtering, the sputtering of surfaces of artificial earth satellites and space ships, destruction of metal by ion bombardment in plasma and ion engines, and the contaminations of plasmas in thermonuclear devices. The section headings are: 1. Introduction. 2. Theory of radiation damage. 2.1. Cascade displacements of atoms. 2.2. Thermal spikes. 2.3. Displacement zones. 2.4. Replacement collisions. 2.5. Crowdions. 2.6. Depleted zones. 3. Focusing of atomic collisions. 3.1. Propagation of collisions along a linear chain of atoms. 3.2. Focusing and crowdion collisions. 4. Formation of focusons in phase-centered cubic metals. 4.1. Focusing of atomic collisions in the

ACCESSION NR: AP4043067

<110> direction. 4.2. Replacement with focusing in the <100> direction. 4.3. Replacement with focusing in the <111> direction. 4.4. Dependence of the number of focusons on the total number of displacements. 4.5. Interaction of focusons with lattice defects. 5. Formation of focusons in body-centered cubic metals. 5.1. Focusing of atomic collisions in the <111> direction. 5.2. Focusing of atomic collisions in the <100> direction. 5.3. Focusing of collisions in the <110> direction. 6. Formation and propagation of focusons in other crystal structures. 7. Study of atomic collision focusing of high-speed electronic computers. 8. Experimental confirmation of the existence of atomic collision focusing by the crystal lattice. 8.1. Cathode sputtering of face-centered cubic metals. 8.2. Cathode sputtering of polycrystalline face-centered cubic metals. 8.3. Cathode sputtering of body-centered cubic metals. 8.4. Cathode sputtering of diamond structure metals. 8.5. Cathode sputtering of hexagonal metals. 8.6. Effect of nuclear charges of moving and stationary particles on cathode sputtering.

ACCESSION NR: AP4043067

8.7. Effect of specimen temperature on cathode sputtering. 8.8. Study of angular distribution of sputtered particles in the bombardment of metals by ion beams. 9. Experimental confirmation of the part played by focusing processes in radiation damage in metals. 9.1. Electron-microscope observation of radiation damage. 9.2. Direct observation of radiation damage. 10. Explanation of the changes in the properties of metals under irradiation, in terms of atomic collision focusing. 11. Experimental methods of studying atomic collision focusing. 11.1. Investigation of cathode sputtering in a glow discharge. 11.2. Study of cathode sputtering by means of ion guns. 11.3. Study of cathode sputtering with an electron microscope. 11.4. Observation of focusons with the ion projector. 11.5. The preparation of thin single crystal and polycrystalline metallic targets. Orig. art. has: 49 figures and 49 formulas.

ASSOCIATION: None

ACCESSION NR: AP4043067

SUBMITTED: 00

ENCL: 00

SUB CODE: SS

NR REF SOV: 031

OTHER: 095

Card 5/5

L 42049-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(b) JD

ACCESSION NR: AP5010939 UR/0286/65/000/007/0122/0122

AUTHORS: Garber, R. I.-G.; Polyakov, L. M. 18 B

TITLE: A method for determining inherent plasticity. Class 42, No. 169848

SOURCE: Byulleten' izobreteniy i tovarnykh znakov, no. 7, 1965, 122

TOPIC TAGS: plasticity, deformation rate, density determination

ABSTRACT: This Author Certificate presents a method for determining the inherent plasticity of metals, alloys, and nonmetallic solid materials. To increase the accuracy of estimating the inherent plasticity, the macroscopic density of the specimen is measured during plastic deformation, while the deformation, during whose uniform increase there occurs a sharp decrease of plasticity, is taken as the characteristic of the inherent plasticity.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physico-technical Institute, AN UkrSSR)

SUBMITTED: 25Jul63 ENCL: 00 SUB CODE: IE

NO REF SOV: 000 OTHER: 000

Card 1/1 dm

L 25075-65 EWT(1)/EEC(b)-2/T IJP(c)
ACCESSION NR: AP5003430 S/0181/65/007/001/0161/0166

AUTHOR: Garber, R. I.; Stepina, Ye. I. 19 15

TITLE: Speed of vanishing of elastic twins in calcite

SOURCE: Fizika tverdogo tela, v. 7, no. 1, 1965, 161-166 B

TOPIC TAGS: calcite, twinning, elastic twin, twin velocity, dislocation motion, temperature dependence

ABSTRACT: The vanishing of elastic twins in calcite following a rapid removal of the load was measured by high speed motion picture photography. A diagram of the equipment is shown in Fig. 1 of the enclosure, and an FP-22 camera was used for the photography. An additional lens in front of the camera made it possible to take pictures in natural size on 8 mm film at 100,000 frames per second. The results have shown that the speeds of the twins reach tens of meters per second, which is much higher than the value obtained by F. P. Bowden and R. E. Cooper (Nature v. 195, 1091, 1962). An analysis of the kinetics of stress removal in a crystal leads to the assumption that the speed of the twinning dislocations in

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ACCESSION NR: AP5003430

calcite can be not lower than 100 m/sec. The temperature dependence of the process was determined by placing heating coils, wound on flat thin mica plates, on both sides of the crystal. These heaters could raise the sample temperature to 400C. Tests have shown that the speed of the process increases with increasing temperature. "The authors thank Ye. V. Kul'kov and V. A. Arinichev of the Leningrad Mechanical Institute for making possible the use of the camera and for interest in the work." Orig. art. has: 7 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institute AN UkrSSR, Khar'kov (Physicotechnical Institute, AN UkrSSR)

SUBMITTED: 08Jul64 ENCL: 01 SUB CODE: NP, ES

NR REF SOV: 002 OTHER: 006

Card 2/3

L 25075-65
ACCESSION NR: AP5003430

ENCLOSURE: 01

O

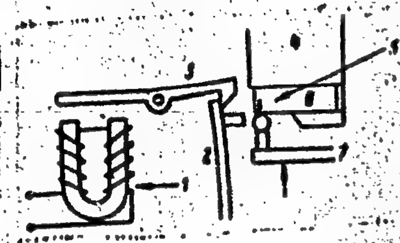

Fig. 1. Diagram of instrument for fast unloading of crystal.

1 - Electromagnet, 2 - spring with striker, 3 - detent, 4 - clamp for crystal, 5 - elastic twin, 6 - crystal, 7 - loading spr spring.

A sphere is shown between the spring 7 and the crystal 6.

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APPROVED FOR RELEASE: 07/19/2001 CIA-RDP86-00513R000514320001-5"

L 25074-65 EWT(1)/T/EEC(b)-2/EWP(1) IJP(c)
ACCESSION NR: AP5003431

S/0181/65/007/001/0167/0176

24
21
B

AUTHOR: Garber, R. I.; Polyakov, L. M.

TITLE: Change in density under plastic compression of ionic crystals

SOURCE: Fizika tverdogo tela, v. 7, no. 1, 1965, 167-176

TOPIC TAGS: density change, stress measurement, strain measurement, rupture strength, ionic crystal

ABSTRACT: The purpose of the investigation was to study further the processes participating in failure under plastic deformation, by determining the connection between the stress, strain, and the residual changes in the density. To this end, samples of natural rock salt and of potassium chloride grown from the melt were subjected to uniaxial compression, and the stress, strain, and relative change in volume were measured. The samples were parallelepipeds measuring 5--6 mm in cross section and 14--16 mm in length. The change in volume was measured with the aid of equipment similar to that described by Bridgman (J. Appl. Phys. v. 20, 1241, 1949). The results show that plastic compression of the crystals leads to a residual change in density, which is due to the competing influence of the disper-

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L 25074-65
ACCESSION NR: AP5003431

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sion and renewal of the contacts. During the initial stages, the density increases, after which it decreases and remains constant within a certain strain interval. Further deformation leads to an abrupt decrease in the density, which continues up to the instant when the crystal fails. In a region of relatively small change in density, the main process is the subdivision of a crystal into blocks, with formation of ultramicroscopic defects. The abrupt decrease in density is connected with the formation of large defects, the growth of which leads to failure of the crystal. Almost the entire plastic part of the deformation occurs with the average sample density changing by approximately 10^{-5}, whereas local changes in the density near the slip bands amount to 10^{-4}. "The authors thank V. K. Sklyarov and V. I. Bashmakov for help with the measurements." Orig. art. has: 11 figures and 2 formulas.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR, Khar'kov (Physicotechnical Institute, AN UkrSSR)

SUBMITTED: 08Jul64 ENCL: 00 SUB CODE: SS, MC

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Card 2/2

L 38528-65 EEC(b)-2/EWT(1)/EWT(m)/EWA(c)/T/EWP(t) Pi-4 IJP(c) GG/JD

ACCESSION NR: AP5005282 S/0181/65/007/002/0459/0463

AUTHOR: Garber, R. I.; Stepina, Ye. I.

32
28
B

TITLE: Possible mechanism for multiplication of twinning dislocations

18

SOURCE: Fizika tverdogo tela, v. 7, no. 2, 1965, 459-463

TOPIC TAGS: twinning, dislocation loop, dislocation motion, crystal imperfection, crystal inclusion

21

ABSTRACT: The authors propose a new mechanism for multiplication of twinning dislocations, which may be effective in the case of crystals with a limited number of sources. The mechanism is similar to that which gives rise to slip dislocations near inclusions in a perfect crystal at sufficiently low general stress level, as observed by J. J. Gilman (J. Appl. Phys. v. 30, 1584, 1959), differing from the latter only in that the elastic field of the twinning dislocations moving in the neighboring layer may also participate in the production of the loop and may also be concentrated on the inclusion. The newly produced loops expand under the influence of applied stresses and give rise to new loops on concentrator inclusions which they encounter. This possibility of dislocation-loop nucleation on the con-

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ACCESSION NR: AP5005282

centrator, in conjunction with the low energy of formation of a two-dimensional nucleus on the boundary between the twin and the parent crystal, may make possible transverse growth of a twin layer due to the formation of plain nuclei on the boundary in the presence of random inclusions near the boundary. Such a mechanism agrees with the features of twinning in calcite. The concentrators may be of different sizes and may concentrate the stresses in different manners. The estimated critical dimensions of the created stable loops, assuming the stress on the boundary between the twin and the parent crystal to be in the range from 40 to 400 g/mm^2, is from 0.3×10^{-3} to 0.3×10^{-4} cm. It is pointed out in the conclusion that the described mechanism is suitable for any crystal, being independent of the structure, and does not pertain to twin formation in perfect crystals. "The authors thank A. M. Kosevich, I. A. Gindin, and V. L. Indenbom for a discussion of the work." Orig. art. has: 2 figures.

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Card 2/2

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IJP(c) GG/JD/JG
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B

AUTHOR: Garber, R. I.; Dranova, Zh. I.; Mikhaylovskiy, I. M.

TITLE: Direct observation of the restoration of a contact between fragments of a tungsten microcrystal 16

SOURCE: Fizika tverdogo tela, v. 7, no. 2, 1965, 496-501

TOPIC TAGS: tungsten 27, recrystallization, 14 microblock dispersion, crack evolution 18, autoionic microscope

ABSTRACT: This investigation was aimed at further confirmation of a hypothesis advanced by one of the authors previously (Garber, UFZh v. 1, 88, 1956; FTT, v. 2, 1089, 1960) that plastic deformation can be regarded, starting with a certain stage, as simultaneous dispersion of microblocks and restoration of contact between fragments. Using an auto-ionic microscope, the authors observed the formation of a crack in a single crystal 29 of tungsten at liquid-nitrogen temperature, under the influence of the quenching stresses and of the force produced by an electric field. The evolution of the crack during the course of evaporation of a

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